MBSS Round Three Planning Meeting

March 1, 2006

PURPOSE OF TODAY'S MEETING

- Review the Glorious History of the MBSS
- Describe DNR's Plans for Round Three
- Solicit Comments on Round Three Plans
- Discuss Alliances (Partnerships) to Achieve New Goals

OVERARCHING MBSS THEMES

Round One (1995-1997)

1 Constructing Baselines

2 Developing Indicators

Round Two (2000-2004)

1 Filling Gaps

2 Forging Alliances

Round Three (2007-2011)

1 Tracking Trends

2 Expanding Alliances

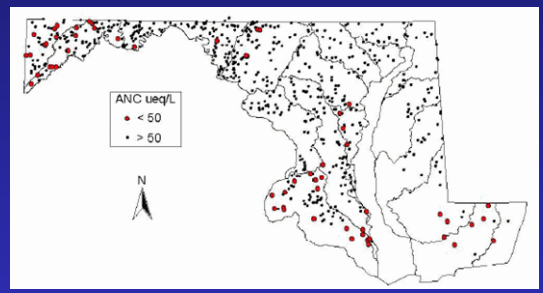
MBSS Objectives

A primary MBSS objective is to evaluate effects of acidic deposition on Maryland streams. It has been demonstrated in a number of Maryland studies that deposition of acidic materials may affect both aquatic and terrestrial resources. Through the MBSS, a comprehensive assessment of the extent to which acidic deposition is affecting critical freshwater biological resources will be done both spatially and temporally.

The secondary objective of the MBSS is to assess with known confidence the current status of biological resources in **non-tidal** streams and rivers in Maryland. The current status of most freshwater ecosystems is unknown, and relationships between biological conditions and environmental factors in these freshwater habitats are poorly understood. The State of Maryland designed the MBSS to assess the fishability and biological integrity of freshwater systems in Maryland.

Where Have We Come With the MBSS?

It all started with acid rain:



- 1987 MSSCS
- ETF Funding
- need for biological and habitat data

1990- The talk about a survey starts

1991- MBSS Scoping Workshop

- Several "doubting Thomases" (randomly-based stream survey *couldn't be done*)
- Exhaustive list of Management Questions
- Versar becomes heavily involved in MBSS planning

1993 Pilot Study

- Four watersheds
- Connectivity major goal
- Work "bugs" out of sampling methods
- Estimate staff time to located and sample each site
- Matt Kline starts MBSS sampling
- 3 crews- AL, WREC, DNR

1994 MBSS Demonstration Project

- Seven river basins
- Test the random design, field, and lab methods at the basin scale
- Scott Stranko and Tony Prochaska hired by DNR

1995 - 1997 MBSS Round One




- 6-digit scale
- Provided data for IBIs
- Basin reports
- REMAP Grant ($400k)
- MDE and DNR reorganize (MBSS gains Marty Hurd, Ann Schenk, and Dan Boward)
- Chris Millard joins the fun!

1998 – 1999 MBSS Between Rounds

- Tidal freshwater pilot
- EMAP/MBSS methods comparison
- First symposium at St. Mary's College
- Fish and invertebrate keys
- "From the Mountains to the Sea"
- Stranko Brothers streams film

2000 - 2005 Second Round

- 8-digit scale
- Wadeable streams biocriteria developed
- PHI refined
- Stream Waders begins
- Jay Kilian hired by DNR
- MBSS trainings become very popular
- NPS, WSA and WDCP funding

2003 MBSS Retreat

- More support for TALU
- More biodiversity-related work
- Additional habitat parameters (e.g., BEHI)
- Better coordination with counties
- Additional samples (e.g., bacteria; periphyton)
- More targeted sampling

Data Quality

- Comprehensive QA/QC Program
  - Training
  - Testing
  - Protocol documents
  - Field audits
  - Annual QC Reports

EPA United States Environmental Protection Agency

Pilot Study for Montgomery County and Maryland DNR Data Integration: Comparison of Benthic Macroinvertebrate Sampling Protocols for Freshwater Streams

County/MBSS Methods Comparison

Data Uses (non-DNR)

- MDE - biocriteria; 303(d); stressors; Tier II waters; STORET
- MDP – GISHydro
- CBP – Restoration Goals
- Local Govts. - NPDES; WRAS; site-specific projects
- Consultants - site-specific projects for SHA, etc.
- ICPRB – basinwide IBI
- SERC – non-tidal/tidal connectivity
- USFWS – good habitat sites
- USCOE – restoration site evaluation
- EPA – WSA; HAP
- NPS - inventory
- Watershed Groups/Schools – restoration work, clean-ups, stewardship, education
- Academics – publish, publish, publish

MBSS
Where Are We Now?

- Who are we now?
- Recent Accomplishments
- Current Work

Who are we now?

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
Appalachian Laboratory

VERSAR INC.

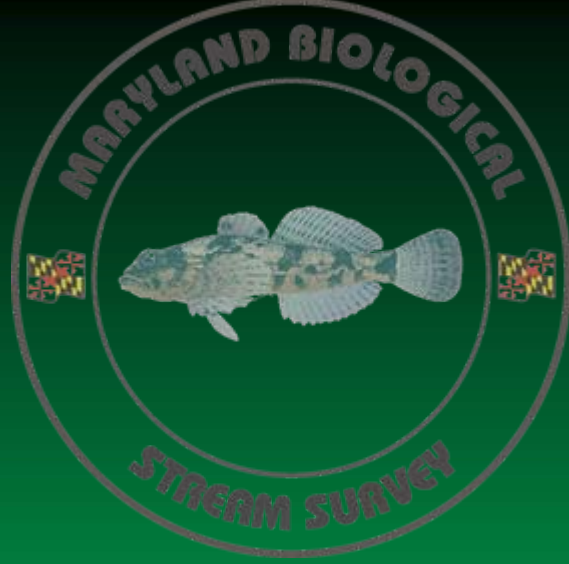
TETRA TECH, INC.

FROSTBURG
STATE UNIVERSITY

Current MBSS Collaborators

	Share data/tech assist	Provide funding
MDE	X	
DNR Fisheries Service	X	
Counties	X	
SERC	X	
UMBC	X	
University of Maryland	X	
Towson University	X	
USFWS		X*
Governor's Initiative (Corsica)		X*
DNR PPAD (ETF)		X
DNR Natural Heritage Division	X	X
National Park Service		X**
EPA	X	X**
CZM (NOAA)		X**

* Funding has not yet begun ** Funding due to end in less than 1 year



Recent Accomplishments…..

Second Maryland Streams Symposium

Presented results from 1st two rounds of MBSS
Carroll Community College
August 10-13, 2005

450 attendees representing 156 separate organizations

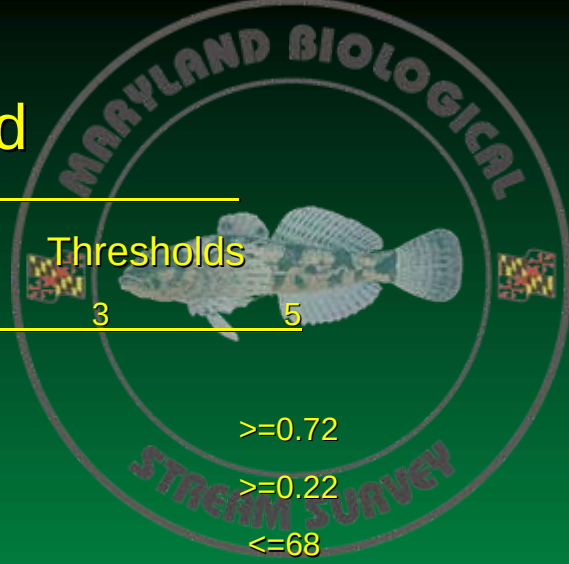
MBSS Results Printed in 15 Report volumes:

1 – 5; annual assessments of watersheds sampled (2000-2004)
6; Laboratory, Field and Analytical Methods
7; Statewide and Basin Conditions
8; County Results
9; Aquatic Biodiversity
10; Riparian Zone Condition
11; Sentinel Site Network
12; Changes in Condition
13; Fishery Resources*
14; Stressors Affecting Maryland Streams
15; Monitoring for Results*

*Not yet complete

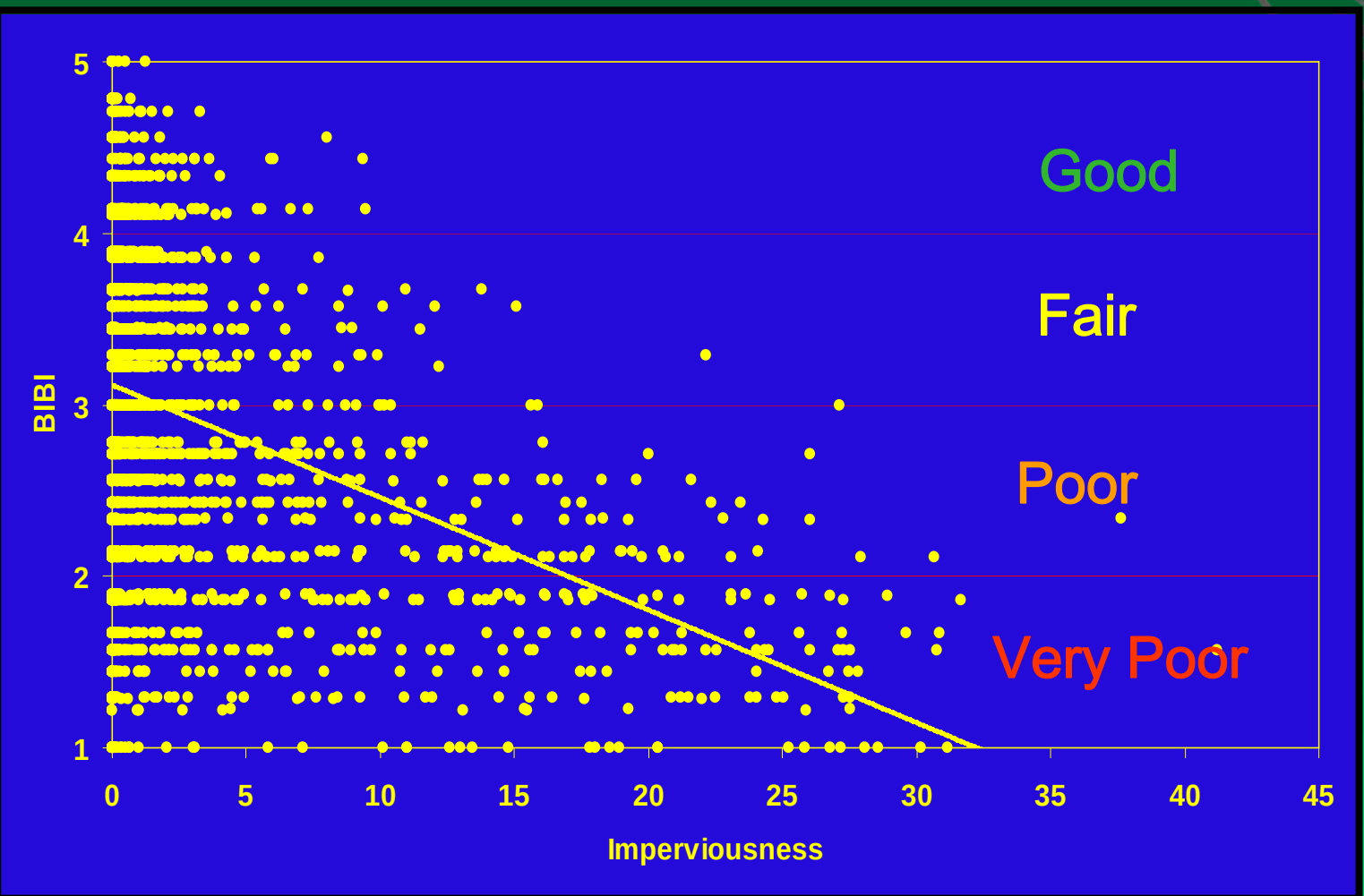
Copies given on CD to Symposium attendees
Also available on internet
www.dnr.state.md.us/streams/mbss/mbss_pubs.html

New Fish IBIs for Maryland

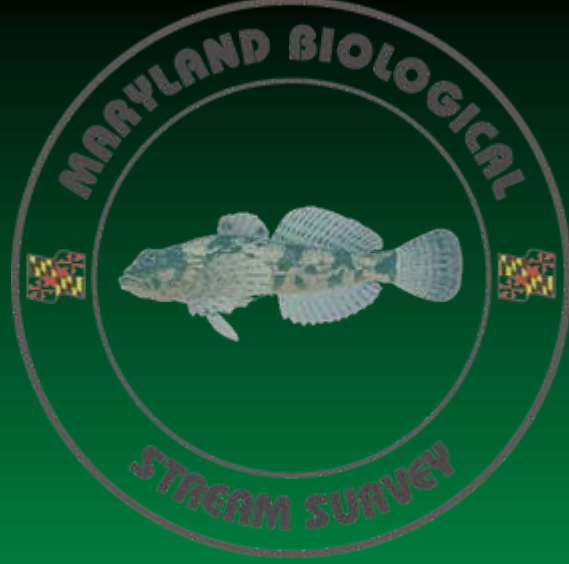


	Thresholds	
	1	3	5
Coastal Plain			
Abundance per square meter	<0.45		>=0.72
Number of Benthic Species Adjusted	0		>=0.22
Percent Tolerants	>97		<=68
Percent Generalists, Omnivores, Invertivores	100		<=92
Percent Non-tolerant Suckers (all suckers except white sucker)	0		>=2
Percent Abundance of Dominant Species	>69		<=40
Coldwater Highlands			
Abundance per square meter	>=2.24		<=0.88
Percent Tolerants	>=0.81		<=0.22
Percent Brook Trout	0		>=0.14
Percent Sculpins	0		>=0.44

Relate biology to natural and anthropogenic variables



Relate biology to natural and anthropogenic variables

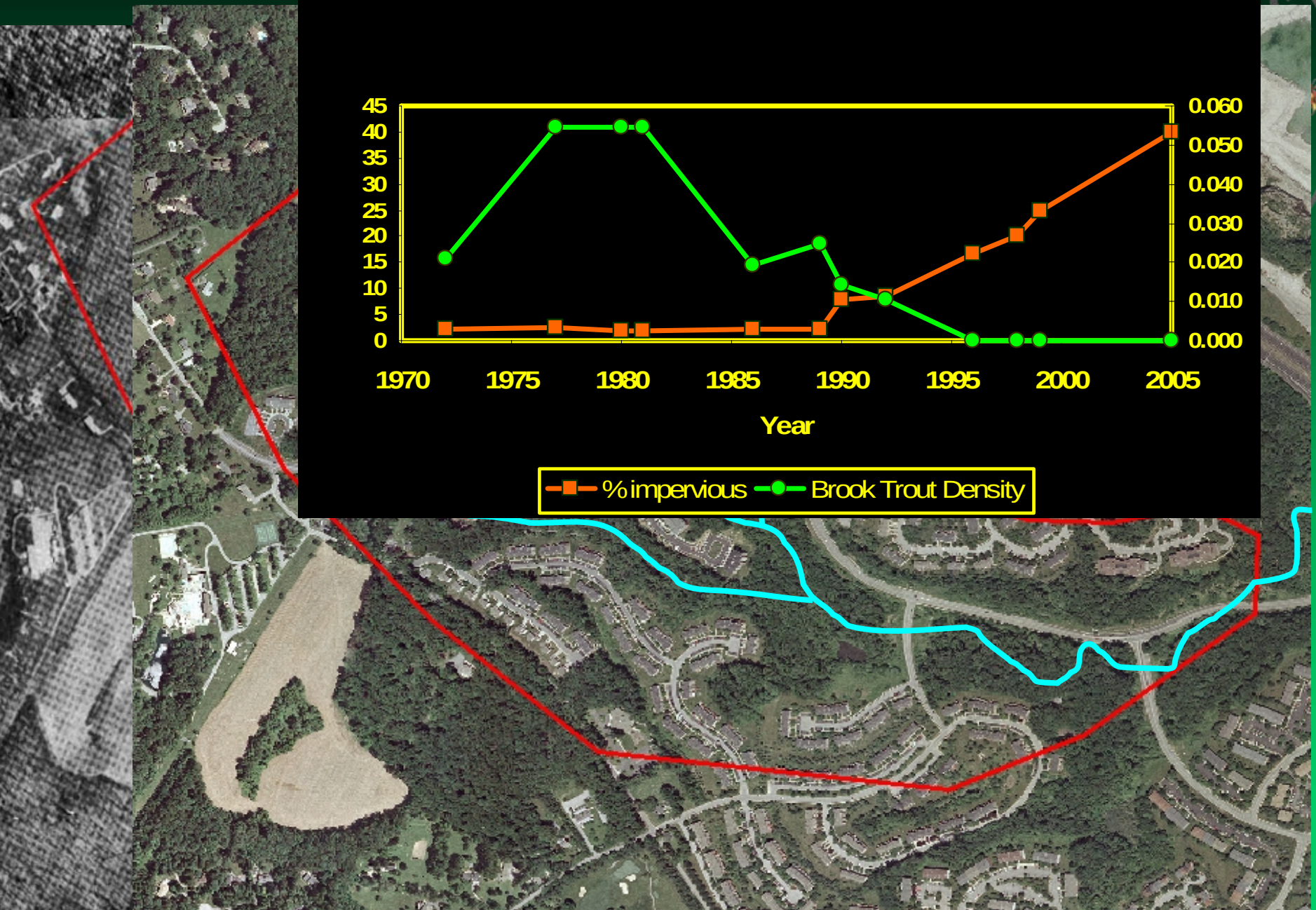


Salamander Species Present

Seal Salamander Northern Spring Salamander Allegheny Mountain Dusky Salamander Long-Tailed Salamander Northern Red Salamander Northern Dusky Salamander Northern Two-Lined Salamander	Northern Spring Salamander Allegheny Mountain Dusky Salamander Long-Tailed Salamander Northern Red Salamander Northern Dusky Salamander Northern Two-Lined Salamander	Northern Red Salamander Northern Dusky Salamander Northern Two-Lined Salamander	Northern Two-Lined Salamander	No Salamanders
< 0.3%	0.3 - 2%	2 - 20%	20 - 37%	>37%

Impervious land Cover

Relate biology to natural and anthropogenic variables



Impacts to brook trout in Maryland streams based on results of a fish prediction model.

	Number of Stream Miles
Urban/Impervious	650
Acid Mine Drain	420
Nutrients (Nitrate/Nitrogen)	190
Riffle Embeddedness	160
Loss of Canopy Shading	140
Bank Erosion	130
Channelization	130
Stable Habitat Structure	75
Non-Native Salmonids	65
Acid Deposition	45
Low Dissolved Oxygen	44
Unknown Acid	30
Poor Riffle Habitat	10
Agriculture	0
Poor Pool Habitat	0

Biodiversity conservation work

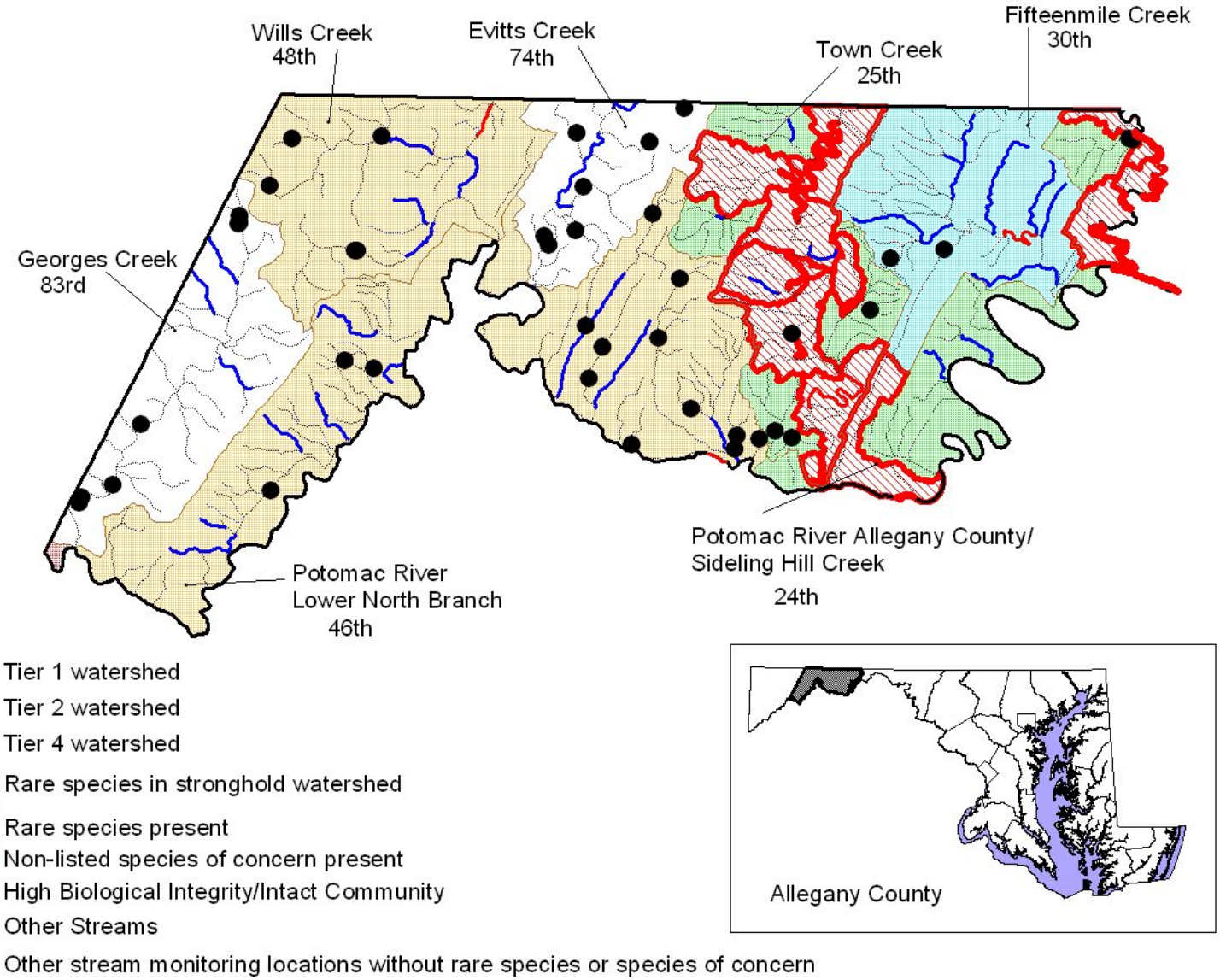


Figure 8-13. Aquatic Heritage Biodiversity Ranking map for Allegany County, by MBSS watershed. Data from MBSS 1994-2004, MBSS qualitative data, Raesly, unpub. data, Harris 1975, and DNR Natural Heritage Program database.

Taxonomic keys

-Fishes
-Benthic macroinvertebrates (family)
-Reptiles and amphibians

occasionally with four dusky longitudinal stripes.

Red Cornsnake
(*Elaphe guttata*)

10b. Dorsal pattern variable, but can be very similar to the eastern corn snake; the postocular stripe stops at the mouth and is entirely dark; the underside of the tail behind the vent is usually not striped; belly markings are usually small and often indistinct; typically less than 100 cm (39 in.) long.

Juvenile Eastern Ratsnake
(*Elaphe alleghaniensis*)

10a. Dorsum is divided into two branches that extend forward and meet in a spear point between the eyes

10b. Postocular stripe stops at the mouth and is entirely dark

11a. Longitudinal stripes on back, sides, or belly. 12

11b. Color pattern does not consist of longitudinal stripes. 15

Educational materials

Examples of Current work

1. Corsica Watershed Restoration Pilot Project
2. Estuarine Research Reserve sampling
3. Surveys for rare stream species
4. Prioritize areas important to conserve biodiversity
5. Conservation plans for species
6. Support WRAS
7. Database re-design
8. Pilot large and rare taxa and larger sub-sampling
9. Small streams

DNR's Needs

- Wildlife and Heritage – inventory; listing; WDCP
- Corsica River Pilot Project - data
- RAS – 305(b) Report; education/public involvement; power plant assessment
- Fisheries – blockages; gamefish data and analyses
- Tributary Strategies Teams – watershed assessments; nutrient data
- Watershed Services – WRAS characterizations; education; GISHydro; Surf-Your-Watershed; Green Infrastructure
- Environmental Review – site-specific data
- Forest and Parks – riparian buffer analyses

Achievable Goals for Round 3

- Assume general and ETF funding remain
- Assume Heritage and Corsica funding continue
- Assume we can hire 2 permanent staff

Achievable Goals for Round 3

We can do:

- 3 crews
- 840 sites/round (168/yr) for "core" MBSS
- 50-60 targeted sites/yr at:
  - sentinel sites
  - Corsica sites
  - rare spp. inventory sites

MBSS Designs: Round 2 and Round 3

Jon Vølstad and Mark Southerland

Versar, Inc.

Columbia MD

MBSS Management Goals

- Assess stream condition statewide and at finer scales to support biocriteria
- Assess trends in stream condition over time
- Characterize distribution of biodiversity and abundance of fish
- Identify stressors

MBSS 1995-97 (Round 1)

- MBSS was designed to produce statewide and basinwide estimates by
  - Defining streams on 1:250,000 map scale
  - Restricted random sampling of basins from three regions to cover all in a 3-year cycle
  - Sample allocations to basins stratified by stream order (1^{st}, 2^{nd}, and 3^{rd}) across basins
  - One randomly selected basin from each region sampled twice (random years) to quantify between-year component of variance in statewide estimates
  - Collecting data from 75 m segments
- Constraints:
  - 300 sites per year (75m segments)

MBSS 2000-2004 (Round 2)

- Change to USGS 1:100,000 scale stream network (i.e., with smaller streams)
- Change primary sampling unit (PSU) from basins (18) to PSU based on Maryland 8-digit watershed scale (84)
- PSUs include 55 stand-alone watersheds and 29 super-PSUs that consolidate small 8-digit watersheds (especially those with mostly tidal streams)

MBSS 2000-2004 (Round 2)

- Constraint:
  - Retain 300 sites per year with 210 core sites
- Stratified restricted sampling of watersheds (PSUs) over 5 years
  - Each PSU sampled once over 5 years
  - 2 random PSUs in each region sampled twice over 5 years to estimate temporal variance component statewide

MBSS 2000-2004 (Round 2)

- Simple or stratified random sample of sites within each PSU:
  - Target of minimum of 10 in spring per PSU to achieve acceptable precision within constraints
  - Equal probability of selection of sites across PSU streams
  - 2 strata for 1st-2nd and 3rd-4th orders when higher order at least 10% of stream miles (min 2 sites per stratum)
  - Stratification by watershed in super-watershed PSUs
  - Allocation of samples to strata proportional to length of streams
  - Simple random sampling (SRS) when < 10% of streams of higher order
  - SRS within PSU to replace initial sites that are unsampleable

MBSS 2000-2004 (Round 2)

- Allocation of additional sites to 22 large PSUs with > 100 nontidal stream miles to reduce variance of key parameters

  (106 additional sites total)
- Lower Monocacy River is largest with 10 + 11 additional = 21 total sites

MBSS 2007-2011 (Round 3) Core Design Principles

- Systematic random design consistent with round 2 design
  - Retain the round 2 sampling cycle to cover all PSUs over 5 years (i.e., each PSU will be sampled (5 + n) years apart, where n is the number of year(s) between each round)
  - It is strongly recommended to fix ‘n’ for long-term monitoring
  - Assessments at fixed intervals improves ability to detect trends
  - Random start ensure unbiased estimates
  - Ease planning for cooperators
- Possible drawback:
  - Susceptible to poor estimates in case of cyclical patterns (very unlikely!)

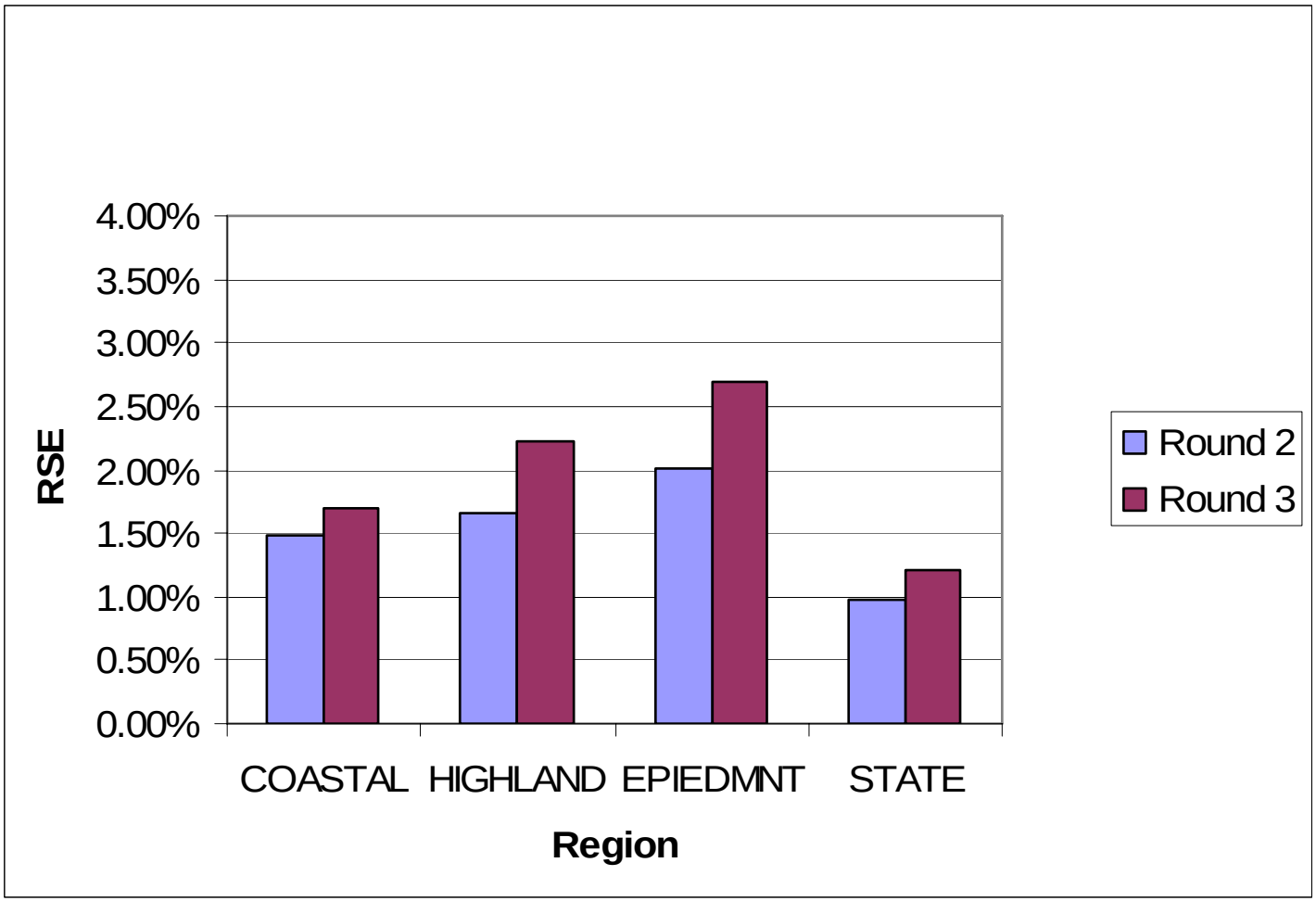
MBSS Round 3
Additional Design Modifications

- Implement sampling with “partial replacement”
  - Retain 50% of sites (5) selected at random within each PSU from sites that were sampled in Round 2
  - Select remaining sites in each PSU by simple random sampling to achieve target sample size (10)
- Advantages:
  - Improves detection of trends by reducing spatial sampling variability
  - Reduces chance of “flip-flops” in designation of impairment from one round to the next
  - Improves permission rates and ease logistics effort

MBSS Round 3
Consolidating the Sampling Effort While Supporting Core Objectives

- No repeat sampling of PSUs within a round (i.e., 6 PSUs of effort avoided)
- Sampling no more than 10 sites per PSU, with additional reduction to 5 sites for a sub-set of PSUs (15 total) with expected minimal change from round 2
- Total savings of 303 sites over the 5-year cycle as compared to round 2 effort
- Drawback:
  - Possible bias in the temporal variance component of statewide estimates (likely to be minor);
  - PSUs with low sampling effort (< 10) can only be assessed by "borrowing information" from the prior round;
  - "Partial replacement sampling" not practical for PSUs with 5 samples

Expected Relative Standard Error (RSE) of Mean B-IBI for Proposed Round 3 Design (vs. Round 2)



Conclusion

- The precision of regional and statewide assessments remains high under the proposed design
- Systematic sampling is effective for long-term monitoring
- The use of ‘moving average estimators’ for the limited number of watersheds with 5 samples is a reasonable compromise when change is slow from one round to the next

Acknowledgements

- We thank Ed Weber for analysis support
- Ron Klauda and Dan Boward for design considerations

The Maryland Biological Stream Survey: Changes to Round Three Field Protocols

Chris Millard
Maryland Department of Natural Resources
Monitoring and Non-Tidal Assessment Division
Annapolis, Maryland

Sampling at each site consists of…

- Fish
- Benthic Macroinvertebrates

- Physical Habitat
- Water Chemistry
- Land Use

Biological Indicators

Fish…

- Fish Index of Biotic Integrity (FIBI)

Benthos…

- Benthic Index of Biotic Integrity (BIBI)

Biological Sampling

Fish – consideration given to…

- Single-pass Electrofishing
- Increasing Site Length
- Standardize Effort

Biological Indicators

Benthos – consideration given to…

- > 100 specimen sub-sample
- Large Rare Taxa
- Family Level ID?

Physical Habitat Variables...

Instream Habitat, Epifaunal Substrate, Velocity/Depth Diversity, Pool/Glide/Eddy Quality, Riffle/Run Quality, Embeddedness, Shading, Woody Debris/Rootwads, Bank Stability, Erosion Potential, Stream Gradient, Sinuosity, Stream Discharge

Water Chemistry Variables...

DO, Temperature, pH, Turbidity, ANC, Sulfate, Nitrate, Nitrite, Ammonia, Total Nitrogen (dissolved and particulate), Orthophosphate, Total Phosphorous (dissolved and particulate), Chloride, Conductivity, and DOC

Land Use Variables...

Riparian Buffer Width/Composition, Adjacent Land Use, Upstream Catchment Land Use

Physical Habitat Variables... Instream Habitat, Epifaunal Substrate, Velocity/Depth Diversity, Pool/Glide/Eddy Quality, Riffle/Run Quality, Embeddedness, Shading, Woody Debris/Rootwads, Bank Stability, Erosion Potential, Stream Gradient, Sinuosity, Stream Discharge

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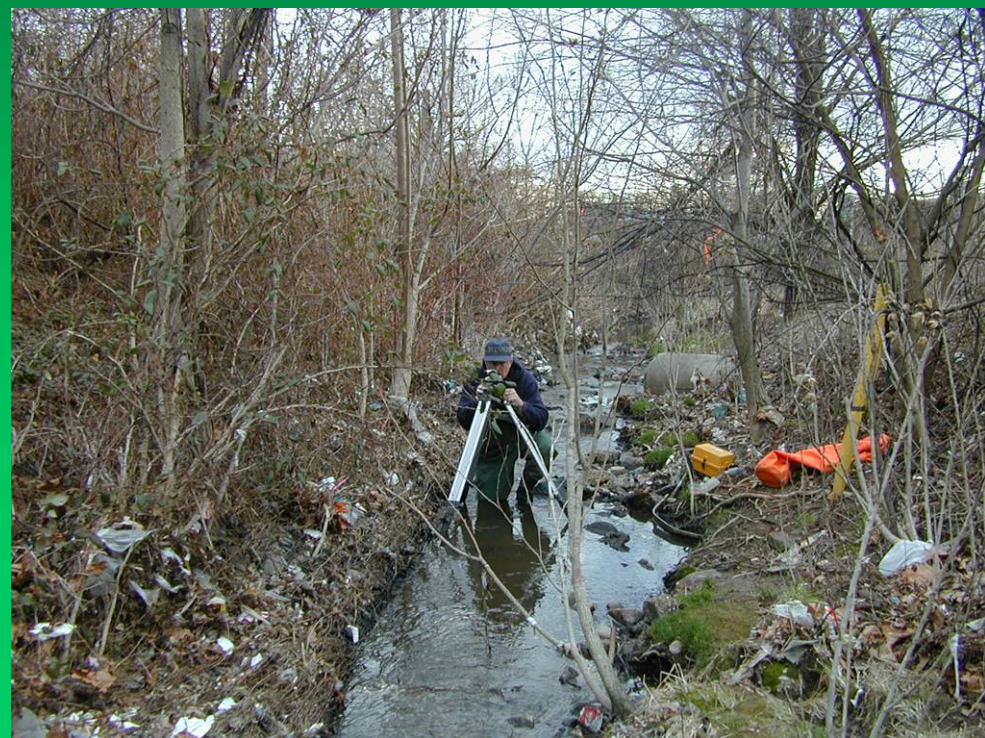
Land Use Variables...

Riparian Buffer Width/Composition, Adjacent Land Use, Upstream Catchment Land Use

Physical Sampling

Habitat – consideration given to…

- New RBP Protocols
- Bank Erosion Hazard Index
- Pebble Counts
- More…



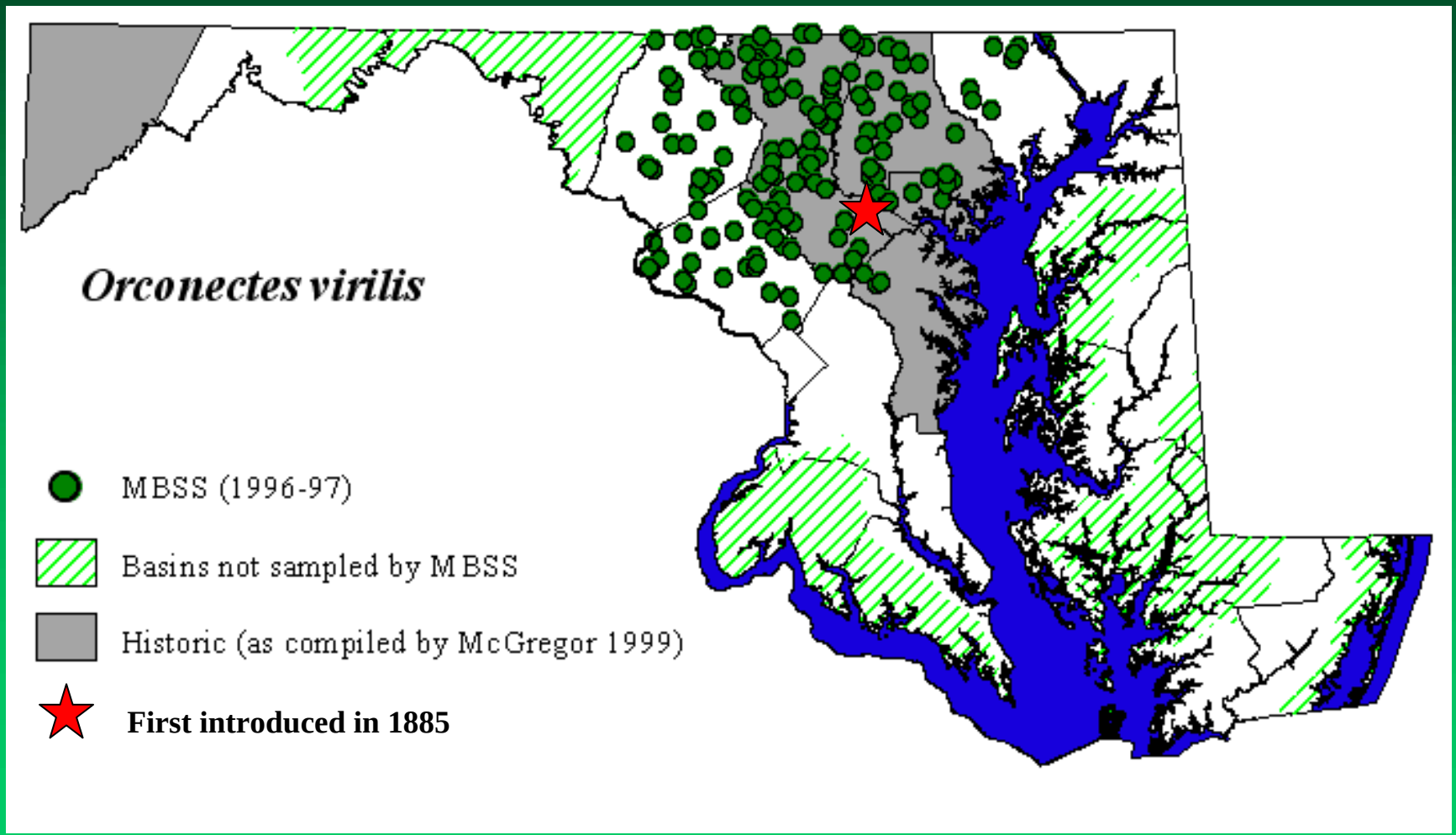
New Protocols will include…

- Crayfish
- Mussels
- Herpetofauna

- Presence/Absence
- Track Distributions
- Voucher Collection

Non-native species...

Orconectes virilis **has displaced two native crayfishes,** ***Cambarus bartonii*** **and** ***O. limosus*** **in portions of Maryland**



MBSS Goals that are currently not achievable

The MBSS plan for round three includes an ambitious set of goals, each of which are important and useful to natural resource management.

However, we are forced to prioritize our goals and present some as currently unattainable - given current staff and resource availability

Limitations = Staff and Funding

MBSS Goals that are currently not achievable

With additional funding we could provide:

1. Targeted sampling to support TMDL monitoring and stressor identification

2. Targeted sampling to assess the effectiveness of restoration

3. Targeted sampling for purposes other than those mentioned above

4. More detailed monitoring of other aquatic taxa (e.g. salamanders, mussels)

5. The extension of the MBSS into tidal fresh streams

6. A description of the link between non-tidal stream quality and tidal stream and river conditions

7. A clearinghouse for Maryland stream monitoring data

8. Finer scale (12-digit watershed) monitoring

9. Visual Assessment of catchment conditions upstream of sites (SCA)

MBSS Goals that are currently not achievable

With additional funding and collaborating expertise we could:

1. Work more closely with counties and other sampling groups to collect data collaboratively

2. Add detail to the MBSS physical habitat assessment (e.g. Bank Erosion Hazard Index)

3. Add endocrine disruptor monitoring to the suite of chemical analytes

4. Send fish for histological examinations to determine if endocrine disruptors (as in #3) are affecting species

5. Collect periphyton data

6. Collect SAV data

7. Add other chemical analytes (e.g. metals, herbicides)